UNIVERSITY OF ILLINOIS,

Agricultural Experiment Station.

CHAMPAIGN, NOVEMBER, 1891.

BULLETIN NO. 18.

DAIRYING EXPERIMENTS.

This bulletin contains reports as follows:

1. Tests of dairy cows at the Illinois State Fair, Peoria, and the American Dairy Show, Chicago, 1891.

2. Experiment No. 106. Investigations of Milk Tests.
   - [*a*] Comparison of Babcock Test with the churn at the American Dairy Show and at the Station.
   - [*b*] A device for measuring the acid used with the Babcock Test.
   - [*c*] A method of marking milk test bottles.

3. Experiment No. 122. Composite Milk Samples Tested for Butter Fat. (Continuation of report in B. 16.)

4. Experiment No. 131. Cream Separation. Test of Methods. Observations on the per cent of butter fat in skim-milk when milk has been set in cans at different depths; also per cent of butter fat in the skim-milk at the bottom, middle and top of the cans.

5. Experiment No. 115. Cream Raising by Dilution. Observations on the rate at which cream rises when the milk has been diluted with water; and as to whether the rising of the cream is hastened by the reduction in temperature or by the dilution of the milk.

STATE FAIR TEST.

The Illinois State Board of Agriculture offered prizes for cows whose milk should be tested at the State Fair at Peoria, Sept. 28 to Oct. 2, 1891, and at the Dairy Show in Chicago, Nov. 11 to 21, 1891. At the request of the Board, through Mr. S. W. Johns, superintendent of the dairy cattle classes, the milk was tested by the chemist of this Station.

At the State Fair the competition was for first and second prizes to cows over three years old, and for like prizes to those under three years old in each of the following breeds: Ayrshire, Holstein-Friesian, Jersey, and Shorthorn; also for a sweepstakes premium to the cow exceeding all others in the test. The prizes were awarded to cows producing the most butter fat in the one day's test, made Sept. 29th. The Shorthorn cows were tested for two days in accordance with requirement of the American Shorthorn Breeders' Association, which offered a special prize for cows of that breed.

The table on pp. 20 and 21 gives the results. In each class the cows are given in order of production of butter fat. The weights of the cows are estimates made in most cases by their owners.

No very striking variation in the composition of the milk given by any one cow at different milkings is shown. Some cows gave the richest milk at night, some in the morning. Generally the cows which were milked three times each day gave the richest milk at noon.

It is well known that a short test at a fair may not show the average capacity of the cow.

AMERICAN DAIRY SHOW TEST.

For the Dairy Show, in connection with the Fat Stock Show, the test was required to be for three days. Three cows only competed; two Brown Swiss and one Devon. The cows were weighed the day before the test began. The Brown Swiss cows were also weighed the day after the test closed. The cow Brienz was 20 lb. heavier, and the cow Eliza 20 lb. lighter at the second weighing than at the first.

Mr. Bourquin states that the daily ration of each of the Brown Swiss cows, during the test, was about as follows: 24 lb. mixed grain, made of three parts corn and cob meal, one part ground oats and one part bran; 3 quarts cotton seed meal; 3 quarts linseed meal; 3 pecks carrots. This was fed in three equal feeds daily, with clover hay after each feed. The cows were offered water three times daily.

The results of the test are given in the table on p. 19.

The performance by the Swiss cow, Brienz, is a remarkable one, both as to milk and butter fat produced. It is not known that it has been equalled in either respect by any other cow tested at a public show.

The cows were kept in open stalls, exposed to the sight and handling of visitors. The weather was somewhat unfavorable.

RECORD OF COWS ENTERED FOR THE MILK TEST, AMERICAN DAIRY SHOW, CHICAGO, 1891.

	Milk,	Butter fat.		Milk,	Butter fat.		Milk,	Butter fat.		Total pounds of			Total pounds produced.			
													Per 100 lbs. of wt. of cow.		Per hour.	
	lb.	Per ct.	lb.	lb.	Per ct.	lb.	lb.	Per ct.	lb.	Milk.	Butter fat.	Butter containing 80 per ct. fat.	Milk.	Butter fat.	Milk.	Butter fat.
	Morning, 6 a. m.			Noon, 2:30 p. m.			Night, 9 p. m.									
Brown Swiss Cow, Brienz; 11 years old; weight 1,395 lbs.; last calf Oct. 10, 1891. Owner, A. Bourquin, Nokomis, Ill.																
1st day	30	3.3	0.99	29	4.3	1.247	22.5	4.5	1.01	81.5	3.25	4.06	5.8	0.23	3.4	0.13
2d day	29	3	0.87	29	4.1	1.189	22.5	4.3	0.967	80.5	3.03	3.8	5.77	0 217	3.3	0.126
3d day	30	2.8	0.84	29.75	4.1	1.219	23.25	4.2	0 976	83	3.04	3 8	5.95	0.218	3.46	0.127
Total	89		2.70	87.75		3.655	68.25		2.953	245	9.32	11.66				
Average	29.7	3.03	0.90	29.25	4.17	1.218	22.75	4.33	0.984	81.7	3.11	3.95	5.84	0.222	3.39	0.128
Brown Swiss Cow, Eliza; 10¾ years old; weight, 1360 lbs.; last calf Oct. 15, 1891. Owner, A. Bourquin, Nokomis, Ill.																
1st day	25	3	0.75	23	3.4	0.782	20	3.8	0.76	68	2.29	2.86	5	0.17	2.8	0.095
2d day	24	2.8	0.672	23	3.4	0.782	18	3.5	0.63	65	2.08	2.6	4.8	0.15	2.7	0.086
3d day	24	2.7	0.648	21.25	4.2	0.890	17	4	0.68	62.25	2.22	2.78	4.6	0.16	2.6	0.092
Total	73		2.070	67.25		2.454	55		2.07	195.25	6.59	8.24				
Average	24.3	2.83	0.69	22.41	3.67	0.818	18.3	3.77	0.69	65.08	2.2	2.74	4.8	0.16	2.7	0.091
Devon Cow, Jean; 4 years old; weight, 1002 lbs.; last calf, October 1, 1891. Owner, John Hudson, Moweaqua, Ill.																
							Night, 6 p. m.									
1st day	14	4.1	0.574	.....	.....	.....	12	4.3	0.576	26	1.09	1.36	2.6	0.11	1.08	0.045
2d day	12	4.3	0.516	.....	.....	.....	8	4	0.320	20	0.84	1.05	2	0.08	0.83	0.035
3d day	9.5	4.6	0.437	.....	.....	.....	9.75	4.5	0.438	19.25	0.88	1.1	1.9	0.088	0.80	0.037
Total	35.5		1.527	....	....	.....	29.75		1.274	65.25	2.81	3.56				
Average	11.8	4.27	0.509	.....	.....	.....	9.92	4.27	0.425	21.75	0.94	1.18	2.17	0.092	0.903	0.039

RECORD OF COWS ENTERED FOR THE MILK TEST, ILLINOIS STATE FAIR, PEORIA, 1891.

Name.	Owner.	Age, years.	Last calf.	Approximate weight.	Pounds of milk.			Per cent butter fat in milk.			Total lb. for the day, 24 h.,		Pounds produced per 100 lb. of cow, approximate.	
					Morning.	Noon.	Night.	Morning.	Noon.	Night.	Milk.	Butter fat.	Milk.	Butter at
Holstein-Friesian cows over 3 years old.														
Tirannia	J. H. Packard, New Windsor, Col.	8	Aug.	1,425	29.5	17.75	15.5	2.7	4.6	4	62.75	2.23	4.4	0.157
Empress Josephine	C. F. Stone, Peabody, Kas	6	Aug.	1,500	27	14	13.5	2.7	4.05	3.2	54.5	1.73	3.6	0.116
Rijaneta	Gillett & Son, Rosendale, Wis	11	Aug.	1,300	20.5	9	9.5	1.7	2.2	1.8	39	0.71	3	0.055
Holstein-Friesian cows under 3 years old.														
Mechtchilde, 3d	J. H. Packard, New Windsor, Col.	2	July	1,220	23.5	11	11.75	2.8	3.5	2.8	46.25	1.37	3.8	0.112
Vizzer Queen	W. H. Logan & Son, Seaton, Ill.	2	July	900	15	7	6.5	2.85	3.3	3.6	28.5	0.89	3.2	0.099
Duchess of Springdale, 4th	Gillett & Sons, Rosendale, Wis.	2	July	900	15	6	5	2.4	3.1	2	26	0.64	2.9	0.071
Pride of Winnikee	G. A. Stanton, Greenwood, Ind.	2	Aug.	900	14	.....	14	1	....	1.3	28	0.32	3.1	0.036
Jersey cows over 3 years old.														
Buttercup Gem	George Merna, Wyoming, Ill.	5	Aug.	800	13	.....	13.75	5.6	....	6	26.75	1.55	3.3	0.194
Edith Matin	George Merna, Wyoming, Ill.	6	Aug.	800	15.5	.....	14	5	....	4.8	29.5	1.44	3.6	0.18
Kansas Cinderella	La Veta Cattle Co., Topeka, Kan.	4	July	800	13.5	.....	14	5.3	....	4.8	27.5	1.38	3 4	0.172
Debbie's Pogis Darling	Garretson Bros., Pendleton, Ind.	4	Aug.	800	14	.....	13	5.3	....	4.6	27	1.34	3.4	0.168
Gossamer Signal	Latimer & Miller, Abingdon, Ill.	3	Aug.	800	14	.....	13.5	5	....	4.3	27.5	1.28	3.4	0.16
Edithiro	George Merna, Wyoming Ill.	5	April	800	10	.....	8	6.3	....	6.2	18	1.12	2.2	0.14
Rosetta of Whiteland	La Veta Cattle Co., Topeka, Kan.	16	Sept	1,000	12.75	.....	11	4.1	....	4.6	23.75	1.02	2.3	0.102
Brunette Star	C. Easthope, Niles, O.	7	Aug.	1,000	12	.....	12 25	4.4	....	3.4	24.25	0.94	2.4	0.094

Jersey cows under 3 years old.														
Koffee's Champion Belle	Latimer & Miller, Abingdon, Ill	2	Aug.	700	12.5	.....	12	4.2	....	4.3	24.5	1.04	3.5	0.149
Perfection	La Veta Cattle Co., Topeka, Kan	2	May	700	10	.....	11	4.7	....	4.4	21	0.95	3	0.136
Howland's Signal Era	C. Easthope, Niles, O	2	July	700	10.5	.....	11	4.6	....	4.1	21.5	0.93	3	0.133
Nixie's Signal	Latimer & Miller, Abingdon, Ill	2	July	700	10.	.....	10.5	4	....	4.3	20.5	0.85	3	0.121
Comassie La Veta	La Veta Cattle Co	2	Aug.	700	6	.....	7	5	....	3.5	13	0.54	1.9	0.08
Ayrshire cows over 3 years old.														
Lady Jewess	J. P. Beatty, Pataskala, O	8	....	900	15.5	.....	14	3.4	....	3.2	29.5	0.97	3 2	0.107
Pet Rose	R. J. & W. J. Munce, Clockeyville, Pa	6	July	900	13	.....	15.5	3.2	....	3.3	28.5	0.92	3.1	0.102
Braw Lass	R. M. Carrons, Washington, Pa	5	July	900	10.5	.....	9.75	3.6	....	4.4	20.25	0.79	2.3	0.09
Ayrshire cows under 3 years old.														
Nellie Lisle	J. P. Beatty, Pataskala, O	2	....	700	12	.....	10.5	4.7	....	4.1	22.5	0.99	3.2	0.141
Granny Pender	R. J. & W. J. Munce, Clockeyville, Pa	2	April	700	6	.....	6.5	4	....	3.9	12.5	0.49	1.8	0.07
Clyde	R. M. Carrons, Washington, Pa	2	July	700	8	.....	8.5	2.8	....	2.6	16.5	0.44	2.3	0.06
Shorthorn cows over 3 years old.														
Arabella	J. Henn & Son, Redmon, Ill	3	First day	8	.....	8.5	3.9	....	4	16.5	0.65	.....	.....	
			2d day	9	.....	8.25	4.2	....	3.9	17.25	0.69	.....	.....	
Doodle	J. Henn & Son, Redmon, Ill	4	First day	5.5	.....	5.5	3.6	....	3.8	11	0.4	.....	.....	
			2d day	5.75	.....	6	3.6	....	4	11.75	0.44	.....	.....	
Summary—Averages from the above Record.														
Holstein-Friesian cows over 3 years old				25.7	13.6	12.8	2.3	3.6	3	52	1.55	3.7	0.109	
Holstein-Friesian cows under 3 years old				17	8	9.3	2.2	3.3	2.4	32.2	0.8	3.2	0.08	
Jersey cows over 3 years old				13	.....	12	5.1	....	4.8	25.5	1.28	3	0.152	
Jersey cows under 3 years old				9.8	.....	10.3	4.5	....	4.1	20.1	0.86	2.9	0.124	
Ayrshire cows over 3 years old				13	.....	13	3.4	....	3.6	26	0.89	2.9	0 09	
Ayrshire cows under 3 years old				8.7	.....	8.5	3.8	....	3.5	17.2	0.64	2.4	0.09	
Shorthorn cows over 3 years old				7	.....	7	3.8	....	3.9	14.1	0.54	.....	.....	

Experiment No. 106. Investigation of Milk Tests.

COMPARISON OF BABCOCK TEST WITH THE CHURN AT THE AMERICAN DAIRY SHOW AND AT THE STATION.

The milk given at one milking at 2:30 p. m., November 18th, by the two Brown Swiss cows tested at the Dairy Show at Chicago was taken for churning. The milk weighed 52 lb. and by test contained 1.971 lb. butter fat. It was run through a "Baby" hand separator No. 2. Several samples of the skim-milk were taken as it came from the separator, which showed only a trace of butter fat. The cream weighed 10.25 lb., or 19.7 per cent of the new milk. The tests showed that the cream contained 19.23 per cent butter fat. This cream was ripened for about 24 hours and then churned. The details of the results are given in the table below.

During the progress of the Dairy Show a working dairy was in operation. For this thirty cans of milk were received. Wednesday, Nov. 18, this milk weighed 2,035.25 lb. It was put in a large vat, warmed, and thoroughly mixed. The thoroughness of the mixing is illustrated by the fact that tests of four samples showed no variation in

RESULTS OBTAINED FROM THE CHURNINGS.

	Cream from milk of	
	Brown Swiss cows.	Working dairy
Weight of cream churned	10.25	.....
Temperature of cream churned	61° F.	61° F.
Temperature of buttermilk	59° F.	61° F.
Time of churning	65 min.	17 min.
Acidity of cream [50 c.c.=1-10 normal alkali]	25.5 c.c.	37 c.c.
Weight of buttermilk, lb	15	204.5
Per cent of fat in buttermilk	0.6	0.3
Weight of salted butter from churn, lb.	2 1875	104.5
Weight of butter fat by test of milk, lb.	1.971	84.46
Difference	0.2165	20.04
Percentage increase of churn over test, or of butter over butter fat in the milk	11.5	23.6
Analysis of butter—		
Water, per cent.	15.4	14.15
Butter fat, per cent.	77.24	82.
Salt, per cent	6.6	3.
Curd, per cent	0.76	0.85
Total	100.00	100.00
Pounds of butter fat in the butter	1.689	85.69
Pounds of butter fat in the buttermilk	0.09	0.61
Total	1.779	86.30
Pounds of butter fat in the milk used, as shown by test	1.971	84.46
Difference—loss or gain in the process.	—0.192	+1.84
Per cent. which loss or gain was of total butter fat in milk used	—9.7	+2.17

the per cent of butter fat. One sample was taken from the middle of the vat, two from the ends, and one from the first milk drawn from the faucet. The milk contained 4.15 per cent of butter fat, or 84.45 lb. in the 2,035.25 lb. milk.

This milk was run through a separator in 65 minutes. The speed of the separator was said to be 6,000 revolutions per minute. Traces only of butter fat were found in four samples of the skim-milk taken during the process of separation. It required 9.8 c.c. of one-tenth normal alkali to make 50 c.c. of the milk neutral. After ripening for 24 hours the cream was churned. Details are given in the table above.

The butter obtained from the 52 lb. of Brown Swiss milk was about 3 oz. more than the butter fat in the same milk, as indicated by the tests of the new milk. The butter obtained from the 2,035.25 lb. of milk used in the working dairy was 20 lb. more than the butter fat shown by tests of the milk. This is an increase of the churn over the test of 11.5 and 23.6 per cent respectively.

From analyses of the butters, with the records of weights of butter and buttermilk, the account kept with the Brown Swiss milk shows a loss of 0.19 lb. butter fat, or 9.7 per cent of the total weight of butter fat in the milk started with. Although this is not the finest working that can be done, so small a quantity could easily be lost by adhering to the dairy utensils of processes through which the milk passes to make butter. The account kept with the 2,035.25 lb. of milk in the working dairy shows an increase of 1.84 lb. of butter fat over the total quantity in the fresh milk as tested. This figurative creation of butter fat in excess of what there was in the milk is probably due to the water that the 13 wooden boxes absorbed after they were weighed. The helper who packed the butter into the boxes from the churn had weighed the dry boxes, then dipped each one into cold water, filled it with butter, and from the total weight subtracted the weight of the dry box so that the water absorbed by the boxes appears as weight of butter. The salt added to the butter from the Brown Swiss milk was not weighed, but estimated by the helper and the analysis of the butter shows an excessive quantity.

A comparison of the test and the churn has been made at the dairy of this Station, together with an analysis of the butter, and the accounts balanced well. This work, except the last two churnings, was done by one person, and the dairy utensils used were carefully cleaned to prevent any loss of butter fat in the process. The milk used was from one Jersey cow about one month after calving. In four trials the milk was set in Cooley cans with bottom faucet. Another trial [the third in the tables] was made by setting the milk in shallow pans, which were the common kind used for this purpose, but with a hole at one side near the bottom. This hole was closed with a cork until time to skim the milk, when, by pulling the cork, the skim milk was drawn off till the cream fell to the hole and then the cork was replaced.

RECORD OF THE WEIGHTS AND TESTS OF THE WHOLE MILK AND SKIM-MILK.

Date.	Whole milk.			Milk set in Cooley cans in a refrigerator. Temperature 45° to 48° F.	Skim-milk		
	Pounds.	Butter fat.			Pounds.	Butter fat.	
		per cent.	pounds.			per cent.	pounds.
First trial—							
Oct, 16, a. m.	12.18	3.9	0.475	24 hours	9.5	0.2	0.019
Oct. 16, p. m.	10.18	5.8	0.59	12 "	7.93	1.2	0.095
Oct. 17, a. m.	11.64	4.1	0.479	48 "	9.43	0.1	0.009
Oct. 19, a. m.	11.43	3.6	0.411	24 "	9.25	0.2	0.018
Total.....			1.955				0 141
Second trial—							
Oct. 19, p. m.	10.5	5.8	0.609	36 hours	8.18	0.4	0.0327
Oct. 20, a. m.	12	5.3	0.636	24 "	9.12	0.4	0.0364
Oct. 20, p. m.	10.21	5.2	0.531	12 "	9.12	0.4	0.0365
Oct. 21, a. m.	12.56	4.7	0.589	48 "	10	0.2	0.02
Total.....			2.365				0.1256
Third trial, milk set in shallow pans, temperature 45° to 48° F.—							
Nov, 5, a. m..	9.75	3.7	0.36075	24 hours	8.437	0.05	0.004218
Nov. 5, p. m..	8.5	4.6	0.391	12 "	7.18	0.4	0.02872
Nov. 6, a. m..	9.84	4.1	0.40359	24 "	8.312	0.1	0.008312
Nov. 6, p. m..	8.56	5.2	0.44525	12 "	6.75	0.2	0.0135
Total.....			1.60059				0.05475
Fourth trial—							
Oct. 31, p. m.	8.18	4	0.3275	36 hours	6.375	0.2	0.01275
Nov. 1, a. m..	9.69	3.9	0,3778	24 "	7.75	0.2	0.0155
Nov. 1, p. m..	7.51	5	0.375	12 "	5.593	0.7	0.03916
Nov. 2, a. m..	10.37	5.2	0.5395	24 "	7.75	0.2	0.0155
Total.....			1.6198				0.08291
Fifth trial—							
Nov. 8, p. m .	8.93	5	0.4468	36 hours	6.437	0.2	0.01287
Nov. 3, a. m .	9.88	4.6	0.4542	24 "	7.312	0.1	0.00731
Nov. 4, a. m .	11.25	4.4	0.492	48 "	9	0.1	0.009
Nov. 4, p. m .	7.94	5.7	0.4524	12 "	5.562	1	0.0556
Total.....			1.8454				0.08478

The results from the five churnings (next page) illustrate a gradual change from a loss to a profit by attention to the proper temperature and acidity of the cream churned. In the first trial the temperature of the cream was too high and the cream was not sour enough. This caused a loss of 5.3 per cent of butter fat in the buttermilk; and the butter obtained was 10 per cent less than the total quantity of butter fat in the milk used.

A test of the buttermilk is a good guide for judging of the thoroughness of the churning, and in the above record it can be seen that the per cent of butter fat in the buttermilk gradually decreases from the first to the fifth trial, in which the cream was churned in about proper condition as to temperature and acidity, giving a buttermilk which contained only 0.1 per cent butter fat and a weight of but-

RESULTS OBTAINED FROM THE CHURNINGS.

	First trial.	Second trial.	Third trial.	Fourth trial.	Fifth trial.
Temperature of cream churned, F....	68°	80°	66°	62°	58°
Temperature of buttermilk, F.....	64	74	62	60	58
Time of churning, minutes.....	15	3	10	7	20
Acidity of buttermilk [50 c.c.= 1-10 normal alkali].....	13 c.c.	35.5c.c.	28.5c.c.	36.5c.c.	41.6c.c.
Weight of buttermilk, lb.....	8	8.56	3.875	6	6.78
Per cent of fat in buttermilk.....	5.3	4.9	1.25	0.35	0.1
Weight of unsalted butter from churn..	1.75	2.34	1.8125	1.84	2.156
Weight of butter fat by test of milk...	1.955	2.365	1.6006	1.619	1.848
Difference—loss or gain in the process	—0.205	—0.025	+0.2119	+0.221	+0.308
Per cent which loss or gain was of total butter fat in milk used.....	—10.4	—1.06	+13.24	+13.64	+16.65
Analysis of butter—					
Water, per cent.....	19.56	21.33	15.66	14.95	15
Butter fat, per cent.....	78.94	77.	82.54	83.27	83.2
Curd, per cent.....	1.5	1.67	1.8	1.78	1.8
Total	100.00	100.00	100.00	100.00	100.00
Pounds of butter fat in in the butter..	1.381	1.8018	1.496	1.535	1.7939
Pounds of butter fat in the buttermilk.	0.424	0.4194	0.0484	0.021	0.0067
Pounds of butter fat in skim-milk.....	0.141	0.1256	0.0547	0.083	0.0847
Total.....	1.946	2.3470	1.5991	1.639	1.8853
Pounds of butter fat in the milk used, as shown by test.....	1.955	2.365	1.6006	1.619	1.848
Difference—loss or gain in the process.	—0.009	—0.018	—0.0015	+0.02	+0.037
Per cent. which loss or gain was of total butter fat in milk used.....	—0.46	—0.7	—0.1	+1.23	+2.

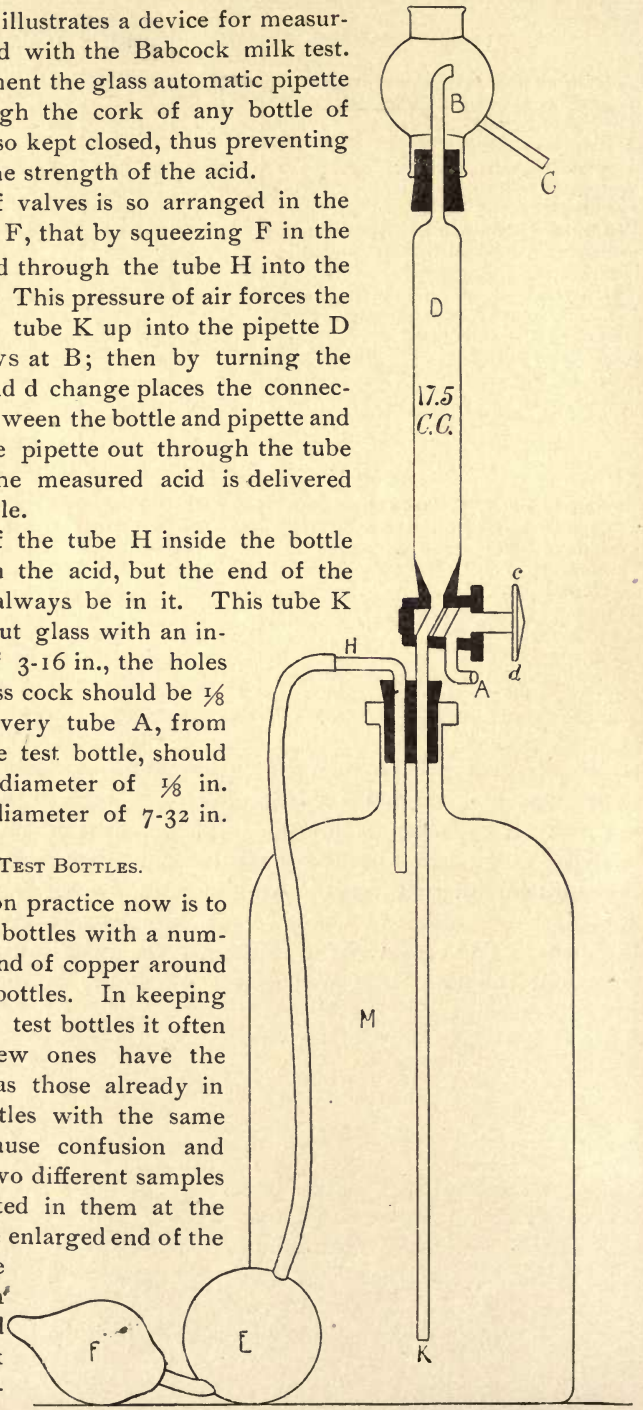
ter 16 per cent greater than the butter fat in the original milk. The butter was weighed and a portion taken for analysis before it had been worked. This accounts for the large per cent of curd found by the analysis. The cream used in these five churnings was separated from the milk in different ways. All the milk was set at a temperature of 45° to 48° F., either in Cooley cans with bottom faucets, or in shallow pans. The cream was not skimmed from the milk in the shallow pans, but the skim-milk was drawn off at the bottom of the can, as before described.

Automatic Pipette.

This figure illustrates a device for measuring the acid used with the Babcock milk test. By this arrangement the glass automatic pipette can be put through the cork of any bottle of acid, which is also kept closed, thus preventing any change in the strength of the acid.

A system of valves is so arranged in the rubber bulbs E, F, that by squeezing F in the hand air is forced through the tube H into the bottle of acid M. This pressure of air forces the acid through the tube K up into the pipette D until it overflows at B; then by turning the cock so that c and d change places the connection is closed between the bottle and pipette and opened from the pipette out through the tube A from which the measured acid is delivered into the test bottle.

The end of the tube H inside the bottle should not touch the acid, but the end of the tube K should always be in it. This tube K should be of stout glass with an inside diameter of 3-16 in., the holes hrough the glass cock should be 1/8 in., and the delivery tube A, from the pipette to the test bottle, should have an inside diameter of 1/8 in. and an outside diameter of 7-32 in.



Marking Test Bottles.

The common practice now is to mark milk test bottles with a numbered ring or band of copper around the neck of the bottles. In keeping up the supply of test bottles it often happens that new ones have the same numbers as those already in use. Two bottles with the same number may cause confusion and guess work, if two different samples of milk are tested in them at the same time. The enlarged end of the the neck of the test bottle often breaks off, and though the break may not be suf-

ficient to prevent using the bottle, the copper band easily slips off and is lost.

A simple and efficient way of marking test bottles is to grind a label on them with a file. Wet with water a flat side of a three-cornered file and use the wet side of the file. File a space about one-fourth inch square at any convenient place on the test bottle, thus making the smooth surface of the glass rough and on this ground label mark numbers with a lead pencil. A good place to file the label is either above or below the graduations on the neck of the test bottle.

Experiment No. 122. Composite Milk Samples tested for Butter Fat.

A report was made in bulletin No. 16 of this Station of trials at the creamery of H. B. Gurler, DeKalb, and at the Station dairy of a method of using composite samples in testing milk. The method of collecting the samples was first described by Professor Patrick in bulletin No. 9 of the Iowa Station. The formula tested in the trials made at DeKalb had been sent by Professor Patrick to Mr. Gurler at his request. As pointed out by Professor Patrick an objection to his method is that the preservative used is a violent poison. To avoid this objection a comparison was made of his method with one suggested by the writer, in which the milk was not poisoned but collected for a week and allowed to sour. By adding to a pint of the sour milk about one-half a teaspoonful of "powdered lye" and mixing carefully, it was demonstrated that composite samples of milk could be accurately tested for butter fat without the use of corrosive sublimate.

This use of "powdered lye" has proved very practical and satisfactory in a number of creameries during the past six months and is now in constant use by them. It has been found to be advantageous to add the lye to the milk the night before the test is to be made, and in not too great quantity. Adding too much lye makes the milk stringy or clotted. When small lumps of curd are slow in breaking up, a more complete mixing is obtained by setting the jar of milk into warm water at about 140°F.

Mr. H. B. Gurler, DeKalb, Ill., contributes the following statements and figures obtained by his use of the methods :

"I am satisfied that the use of lye in the weekly composite samples puts them in condition to give a correct sample for testing. As the weather gets cooler we use less of the lye, and there is more need of warming the jars containing the composite samples, as the cream is liable to adhere to the sides of the jars if lye is not used and they are not warmed. On the whole we are very much pleased with the use of the lye.

"The following table gives the tests or per cents of butter fat in the weekly composite samples of milk brought to the creamery by twenty patrons during October.

BUTTER FAT SHOWN BY WEEKLY COMPOSITE TESTS, PER CENTS.

No. of Patron	Week Ending October					No. of Patron	Week Ending October				
	2d	9th	17th	24th	30th		2d	9th	17th	24th	30th
1	4.3	4	4	4.4	4.2	11	3.9	3.7	3 5	3.4	3.2
2	3.6	3.3	3.6	3.7	3.5	12	3.6	3.7	3.6	3.4	3.4
3	3.6	3.5	3.6	3.7	3.7	13	3.9	3.7	3.8	4	3.8
4	3.6	3.5	4	4	4.2	14	4	3.9	4	4	4.1
5	3.8	3.6	3.6	3.6	3.6	15	3.7	3.8	4.2	4	4.1
6	3.9	3.6	4	4.1	3.9	16	4	3.6	3.8	4	4.1
7	3.8	3.8	3.8	3.4	3.6	17	3.6	3.6	3.4	3.6	3 7
8	4.4	4.8	4.4	4	3.9	18	3.6	4	4	3.8	3.6
9	3.5	3.6	3.4	3.8	out	19	4.2	4.6	4.4	4	4.2
10	4	4.3	3.8	4	4.4	20	3.6	3.6	3.6	4	3.8

"Some of the variations I can account for. No. 11, for instance, had a steady increase in milk from fresh heifers. Some had a decrease from their cows drying off. In the summer months when the conditions of the different dairies were more uniform, the tests ran with a surprising uniformity."

Experiment No. 131. Cream Separation, Test of Methods.

A number of trials were made to observe the completeness of the cream separation after the milk had been set in Cooley cans, temperature 45° to 48°F., 12, 24, 36, and 48 hours. Tests for butter fat were also made of the skim-milk in the bottom and the middle of the can, and of that last drawn off.

The results show that cream is often lost if the skim-milk is drawn off nearer than one inch from the bottom of the cream. The variation in the tests given in the table on p. 29 under the column headed "last skim-milk" shows the necessity of caution in skimming close to the cream. Drawing off the skim-milk to within one inch of the bottom of cream can be done without loss of cream, if the faucet is set so that the skim-milk does not stop running until it has reached the point where you wish it to stop; repeated opening and closing of the faucet has a tendency to mix the cream so that it flows out with the skim-milk.

The summary of this table shows that when the milk of this cow was set in cans to the depth of ten inches the most butter fat was obtained in the cream when the milk had been set 48 hours. This was not much better than setting the milk 24 hours, but considerably better than setting 12 hours. An average of 2.4 per cent of the total butter fat in the new milk was lost in the skim-milk when skimmed after 48 hours standing; 4.05 per cent after 36 hours; 3.7, after 24 hours; and 12.87, after 12 hours.

One trial of separating the cream by diluting the milk with an equal volume of water, showed that 17.2 per cent of the total butter fat was lost in the skim-milk when skimmed after 2 h. standing. The results obtained from setting the milk in shallow pans showed the most complete separation of cream in this trial. Only 1.62 per cent of the total butter fat of the milk was lost in the skim-milk after standing 24 h., and 5.18 per cent after standing 12 h.

More uniformly complete separations of cream than any of the above can be obtained by using a "Baby" hand separator, which we have repeatedly tested, obtaining skim-milk with less than 0.1 per cent butter fat.

RECORD OF THE WEIGHTS AND TESTS OF THE WHOLE MILK AND SKIM-MILK.

Date.	New milk set. lb.	Per cent butter fat in Milk used.	Skim-milk drawn Bottom.	Middle.	Last.	Total.	Per cent of tota butter fat of new milk left in skim-milk.	
Milk skimmed after standing 12 hours.								
Oct. 16	10.18	5.8	0.6	0.8	2	1.2	15.76	Average. 12.87
Nov. 1	7.5	5	0.4	0.6	0.7	0.7	10.55	
Nov. 4	7.93	5.7	0.5	0.8	3.9	1	12.3	
Nov. 5	*8.5	4.6	0.1	0.2	1.9	0.4	*7.34	5.18
Nov. 6	*8.56	5.2	0.2	0.3	0.5	0.2	*3.03	
Milk skimmed after standing 24 hours.								
Oct. 16	12.22	3.9	0	0	0.5	0.2	3.9	3.7
Oct. 19	11.43	3.6	0	0.1	1.9	0.2	4.38	
Oct. 20	12	5.3	0	0.3	0.7	0.4	5.34	
Nov. 1	9.68	3.9	0.2	0.3	0.3	0.2	4.1	
Nov. 2	10.37	5.2	0	0	2.2	0.2	2.87	
Nov. 3	9.87	4.0	0	0	0.4	0.1	1.6	
Nov. 5	*9.75	3.7	0	0	1.4	0.05	*1.17	1.62
Nov. 6	*9.84	4.1	0	0.2	0.4	0.1	*2.06	
Milk skimmed after standing 36 hours.								
Oct. 19	10.5	5.8	0	0.2	6.6	0.4	5.37	4.05
Oct. 31	10.18	4	0	0.1	0.8	0.2	3.9	
Nov. 2	8.93	5	0	0.1	2.1	0.2	2.88	
Milk skimmed after standing 48 hours.								
Oct. 17	11.68	4.1	0	0	0.4	0.1	2	2.4
Oct. 21	12.59	4.7	0	0	1.8	0.2	3.4	
Nov. 4	11.25	4.4	0	0.1	1.6	0.1	1.81	
Milk diluted with an equal weight of water and skimmed after standing 2 hours.								
Nov. 7	9.62	4.9	0.4	0.5	0.5	0.5	17.2	

SUMMARY—PER CENT OF THE TOTAL BUTTER FAT IN THE MILK LEFT IN THE SKIM-MILK

	Milk set in cans, depth of milk 10 in.				Milk set in shallow pans.		Diluted with one-half water.
Time of setting, h.	12	24	36	48	12	24	2
Per cent of total	12.87	3.7	4.05	2.4	5.18	1.62	17.2

*Shallow pan, milk 3 inches deep.

MILK SET IN SHALLOW PANS 3 IN. DEEP AND IN BOTTLES 6 AND 9 IN. DEEP.

No. trial	Manner of setting.	Temp. F. of milk when Set.	After 1 h.	After 2 h.	Per cent of butter fat in Milk used.	Skim-milk after standing 1 h.	2 h.	3 h.	6 h.	9 h.	24h.
1	Shallow pan, depth 3 in.....	95°	82°	77°	3.3	....	1.9	1.5	0.8	0.6	0.1
	Bottle, depth 6 in.....	95	....	....	3.3	2.9	2.3	2.1	1.4	0.9	....
	Shallow pan, half water, 3 in.	73	71	70	3.3	....	0.4	0.25	0.1	0.05	....
2	Shallow pan, depth 3 in.....	97	85	79	2.9	2.5	2	1.6	1	0.6	0.15
	Bottle, depth, 9 in	97	....	....	2.9	2.7	2.3	2	1.5	1.2	0.5
	Pan, half water, 3 in.....	75	72	72	2.9	0.6	0.4	0.3	0.15	0.05	....
3	Shallow pan, depth 3 in.....	96	85	82	3.45	2.4	2	1.6	1	0.7	0.4
	Bottle, depth 9 in.....	96	86	82	3.45	2.8	2.4	2.2	1.6	1.2	0.9
	Pan, half water, 3 in.....	76	74	74	3.45	0.5	0.4	0.3	0.1	0.05	....

During the hot weather in July a comparison was made of the rate at which cream would rise when the milk was 3, 6, and 9 in. deep. A mixture of milk from several cows was used and it was set in a room where the temperature was about 70°F. In each trial the cream rose faster and more completely in the shallow pans 3 in. deep than when set in bottles 6 or 9 in. deep. See foregoing table for results.

Experiment No. 115. Cream Raising by Dilution.

The observations here recorded include a comparison of the rate at which cream rises in hot weather, when the milk of different cows is diluted with an equal volume of water. The benefits of this practice are supposed to be obtained by dairies which do not have ice or a cool place in which to set milk, and where in hot, muggy weather the milk sours before all the cream rises. Under such circumstances it has been suggested that the cream can be separated at once, by adding cold water to the new milk.

EQUAL PARTS NEW MILK AND WATER.

		Temperature, F.					Per cent. of cream	Per cent of butter fat in				
		Dairy	Milk	Water	Diluted milk			Milk used.	Diluted skim-milk after			
					When set.	After 2 h.			1 h.	2 h.	6 h.	9 h.
Cow No. 1—July	1	74°	88°	54°	68°	.....	7.3	.....	1.1	.....	.....	0.4
	2	77	98	60	76	.....	7.3	5.8	1.2	.....	.....	0.5
	3	73	98	59	76	.....	7.3	5.6	1.3	.....	.....	0.5
	9	72	99	58	73	74°	7.4	5.9	1.7	1.3	0.6	0.5
	10	73	99	58	74	74	7.4	5.4	1.7	1.2	0.8	0.5
	11	75	99	59	76	74	7.4	6.3	1.5	1.3	....	0.4
Cow No. 2—July	1	74	88	54	66	.....	7.5	.....	0.3	.....	.....	0.05
	2	77	98	60	75	.....	7.3	.....	0.8	.....	.....	0.2
	3	73	98	59	76	.....	7.3	.....	0.7	.....	.....	0.15
Cow No. 3—July	9	72	99	58	74	75	5.9	3.5	0.6	0.5	0.2	0.2
	10	73	99	58	75	75	5.9	2.9	0.7	0.5	0.3	0.2
	11	75	99	59	76	75	5.9	3.2	0.6	0.5	.....	0.15
Cow No. 4—July	1	74	88	54	66	.....	6	.....	0.3	.....	.....	0.15
	2	77	98	60	75	.....	4.5	2.8	0.7	.....	.....	0.4
	3	73	98	59	76	.....	4.5	2.8	0.6	.....	.....	0.35
	9	72	99	58	75	75	5.9	2.9	0.8	0.4	0 2	0.2
	10	73	99	58	76	75	5.9	2.6	0.9	0.5	0.3	0.1
	11	75	99	59	77	75	5.9	3	.....	.....	.....	....
Cow No. 5—July	1	74	88	54	66	.....	5.9	.....	0.4	.....	....	0.15
	2	77	98	60	74	.....	4.4	3.4	0.8	.....	.....	0.3
	3	73	98	59	76	.....	4.4	3	0.7	.....	.....	0.25
Mixed milk, July	1	74	88	54	68	.....	7.4	.....	0.35	.....	.....	0.2
Cows 1, 2, 4, 5.	2	77	98	60	75	.....	5.9	3.8	0.6	.....	.....	0.25
	3	73	98	59	76	.....	5.9	3.45	0.7	.....	.....	0.35
Mixed milk, July	9	72	98	58	73	75	7.4	3.3	0.6	0.4	0.15	0.1
Cows 1, 3, 4.	10	73	98	58	75	75	7 4	2.9	0.65	0.4	0.3	0.2
	11	75	99	59	76	75	7.4	3.45	0.6	0.4	0.3	0.2

The following trials were made to demonstrate how thoroughly the cream can be separated in this way, and what results would be obtained with the milk of different cows. About one-half a pint of new milk was mixed with the same quantity of water. The mixture was put into wide mouthed glass bottles with a faucet at the bottom by which portions of skim-milk were drawn off for testing. The mixture filled the bottles to a depth of 4 inches. The temperature of the milk was about 98° F. when mixed with water of about 58° F. The temperature of the mixture was about 75° F., and it was kept in a room where the temperature ranged from 66° to 76°F. A test was made of the skim-milk after the mixture had stood 1, 2, 6, and 9 hours.

The details are given in the foregoing table:

The milk used, 250 c.c., was carefully measured each time. A calculation has been made to show the per cent of the total butter fat of the milk which was left in the skim-milk.

PERCENTAGE OF TOTAL BUTTER FAT LEFT IN THE SKIM-MILK.

Milk set.	1 hour.	2 hours.	6 hours.	9 hours.
Cow No. 1, av. of six trials....	46	35.5	22.4	14.9
3, av. of three trials..	35.5	28.7	14.7	10.4
4, av. of six trials....	50	33	16.8	17.3
5, av. of three trials .	43	.....	.....	15.8
Mixture, 1, av. of three trials..	31.5	.....	.....	15
2. av. of three trials..	34.7	23.3	13.9	10.4
Average.....	40.1	30.1	17	14

These tables show that there was quite a variation in the per cent. of butter fat found in the diluted skim-milk from the milk of the same cow on different days. These variations were not so great, however, as that of cow No. 1 from all the others. The milk from cow No. 1 was considerably richer than that from the others and gave a richer skim-milk, but it contained about the same proportion of the total butter fat as the milk from the other cows.

The average of all the results obtained shows that in this trial when new milk was diluted with an equal volume of cold water and kept in a room at about 75°F., there was left in the skim-milk about 40 per cent. of the total butter fat after standing one hour; 30 per cent after two hours; 17 per cent after six hours; and 14 per cent after nine hours.

An experiment was next made to ascertain whether the quick raising of cream by dilution was caused by the sudden change in temperature or by the dilution of the liquid through which the fat globules rise.

The bottles used before were filled to the same depth with new milk. They were then put into a refrigerator until the milk had cooled to about 75°F., taken out and kept in a room at 70° to 75°F.

The details of the record are given in the table.

MILK SET IN REFRIGERATOR TWO HOURS.

	Temperature of refrigerator, F.	Temperature of milk, F.		Per cent of cream	Per cent fat in				
		Set.	Af. 2 h.		Milk used.	Skim-milk after			
						1 h.	2 h.	6 h.	9 h.
Cow No. 1.—July 16	51°	95°	72°	20	6	2.3	1.8	0.9	0.7
" 17	58	96	76	20	7	2.2	1.2	0.8	0.3
Cow No. 3.— " 16	51	99	71	6	2.8	2.2	1.8	1	0.4
" 17	58	100	76	6	3.3	2.1	1.1	0.8	0.4
Cow No. 4.— " 16	51	100	71	6	2.6	2.5	2.5	1.9	1.6
" 17	58	100	76	6	3.1	2.8	1.9	1.7	0.8
Mixed Milk, " 16	51	96	72	8	3	2.4	2.2	1.4	0.9
4 in. deep. " 17	58	97	76	8	3.4	2.5	1.6	1.1	0.5
Mixed Milk, " 16	51	94	75	..	3	2.7	2.3	1.6	1
9 in. deep. " 17	58	95	79	..	3.4	2.4	1.6	1.2	0.6
Mixed Milk, " 16	51	94	73	..	3	2.2	1.7	0.8	0.5
pan 3 in. deep. " 17	58	95	76	..	3.4	2.1	0.8	0.5	0.2

An average of the duplicate trials shows a great difference in the cream rising on milk of the different cows. There is not near the uniformity that was observed when the milk was diluted with water.

The same calculation used before shows the per cent of the total butter fat of the whole milk left in the skim-milk to be as follows:

PER CENT OF THE TOTAL BUTTER FAT LEFT IN THE SKIM-MILK.

Milk set.	1 hour.	2 hours.	6 hours.	9 hours.
Cow No. 1.—July 16.....	30.6	24	12	9.3
" 17.....	25.1	14	9	3.4
Average	26.8	19	10.5	6.3
Cow No. 3.—July 16.....	73.5	60.3	33.5	13
" 17.....	60	31	22.6	11.3
Average	67.7	45.5	28	12.1
Cow No. 4.—July 16.....	90	90	69	57
" 17.....	85	57	50	24
Average	88.5	73.5	59.5	40.5
Mixed Milk.—July 16.....	73	70	43	27
" 17.....	67	43	30	14
Average	70	56.5	36.5	15.5

The results from this work on cream raising by dilution, show [1] that with rich milk and with that from a new milch cow, the cream rose as completely when the new milk was quickly cooled to 70°F. without the addition of water as it did when diluted with an equal quantity of water. [2] The rising of the cream was more complete in a given time, and was hastened by diluting the milk from cows that were not fresh or that gave a considerable quantity of average milk.

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